THE THERAPEUTIC USE OF PASSIVE HYPEREMIA (BIER).

By George P. Müller, M.D.,
ASSOCIATE IN SURGERY IN THE UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.

Introduction. The present conception of inflammatory processes is, that as a result of injury—mechanical, thermal, bacterial—the tissues react locally, and exhibit certain phenomena which always have a distinctive tendency to produce repair of the damaged tissue. The old teaching, that inflammation is harmful and to be combated by every means at our command, has given place to the idea that reaction is necessary after injury, and if it does not occur measures should be taken to promote and increase it. In recent years we have had several important advances in treatment along these lines, and while the principles upon which they are based have been evolved by many workers, yet to Bier,[1] von Mikulicz, and Wright[2] we are indebted for passive hyperemia, methods of increasing the "resistance period," and opsonic therapy.

As a result of irritation to some more or less limited area of the body the phenomena of inflammation appear in a fairly well-regulated manner, and unless overcome by the greater power of the irritant, they inaugurate the sequence of events which we speak of as repair. The transudation of fluid from the vessels into the tissues, the emigration of leukocytes, the formation of new blood paths, and the stimulation and proliferation of the fixed connective-tissue cells are well known as part of the process of repair, and yet most of us are prone to forget that these very processes are not only capable of producing new tissue, but that they are also potent agencies in the removal of the irritant. By noting this fact, we are led to the conclusion that hyperemia and inflammation, up to a certain degree, are beneficial and should be artificially encouraged if the irritant itself does not stimulate nature to produce a degree of hyperemia sufficient to subdue the disease. At first thought the intense swelling, pain, local heat, and redness inseparable from acute inflammation would seem to indicate that the area of infection is suffering from an excessive reaction. But, as Adami[3] remarks: "The majority of cases of acute inflammation, cases which from their symptoms call for interference, are truly examples of inadequate reaction; the forces which the organism has been able to oppose to the irritant have been insufficient to neutralize it."

Before discussing the rationale of Bier's passive congestion, it might be well to consider the reactive processes generally. I know no better scheme than that of Adami into which they may be divided: (1) Reaction inadequate to neutralize the irritant and bring about repair; (2) reaction adequate for these purposes; and (3) excessive reaction. In the natural repair of fractures, the healing of incised wounds, etc., when the irritation is of mild grade and unaccompanied by severe signs or by pus formation the local reaction is adequate, and repair depends upon the healthy condition of the blood and, to a certain extent, of the nervous system. These are dependent, of course, upon a healthy coördination of all the component parts of the organism, as a whole, and the surgeon simply has to bring the wound or injury into such a condition by aseptic methods, etc., that an adequate local reaction is attained, and by regulating the excretory organs such reaction is preserved. No further treatment is necessary.

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[1] Hyperämie als Heilmittel, Leipzig, 1907.

[2] Jour. Amer. Med. Assoc., 1907, xlix, 479, 567.

[3] Inflammation, New York, 1906.

If the reaction is inadequate the surgeon should not attempt to lessen the inflammatory manifestations, but, on the contrary, they should be promoted and even increased in the hope of destroying the irritant locally. As has been remarked already, the symptoms of inflammation may be pronounced and an excessive reaction diagnosticated, but the spreading character or progressiveness of the infection and the general bodily reaction will easily show that the forces of nature are insufficient to cope with the irritant. This class is the one in which Bier's artificial hyperemia finds its use, and Wright's bacterins can be applied with most hope of success.

Excessive reaction is met, according to Adami, in only two conditions: (1) When one or other factor in the process is unduly exalted, the others being unduly low; and (2) in certain cases of what we may term neurotic and referred inflammation. Necrosis, ulceration, adhesions, or cicatrices are not examples of this class, because they simply mean "that the virus is being antagonized at great cost." Virulent infections and low resistance causing paralytic dilatation of the vessels without leukocytic emigration, exhuberant granulations, keloids, the swelling about a sprain of the ankle, etc., are examples in which the hyperemia requires to be lessened, not increased. With these facts in mind we are better able to take up the method whereby Bier induces hyperemia (*Stauungshyperämie*), of which Murphy remarks that there is nothing that has come into surgery in the last ten years as a practical application that appears to him to have as much value.

Of course, the idea is not new, as the production of congestion by cupping, by heat, and by counterirritation was done by the ancients, and, as Bier points out, Paré used the constricting bandage to produce callus formation in badly uniting fractures. Bruns, in 1886, reported five cases treated by congestion, Thomas, in 1886, used the method in 14 cases, and referred to it as "damming," and Helferich, in 1887, again recommended congestion as a stimulus to bone formation. Before these times, however, certain clinicians had stated that pulmonary tuberculosis and pulmonary stenosis often coincided, due to the anemia of the lung, and Rokitansky enunciated the theory that mitral stenosis, with its chronic passive congestion of the lungs, would prevent the development of tuberculosis. The latter statement has since been severely attacked, but they both came to Bier's notice and he proceeded at once (1892) to produce hyperemia in an effort to influence the course of tuberculous arthritis. Encouraged by the results obtained in the treatment of surgical tuberculosis, he enlarged the scope of his method, and applied it to acute and suppurating processes of all kinds. In 1905 Klapp,[4] from Bier's clinic, introduced the use of the various suction apparatus.

It is, of course, clear that we can increase the blood in a given area in two ways: (1) By producing a more active flow of arterial blood by accelerating the local circulation by the application of heat, counterirritants, etc. This is called active hyperemia and has been highly developed by Bier, being especially adapted to the treatment of chronic cases. (2) By obstructing the venous return, the blood is dammed back upon the capillaries, dilating them, and thus increasing the amount of blood (passive hyperemia). The suction apparatus produces both kinds of hyperemia, although Bier and Klapp believe the passive form to predominate. Even in the active form the dilatation of the bloodvessels causes slowing of the current, but as Bier teaches, both the arterial and venous hyperemia act so nearly alike as to make discussion on this point of little moment. Another fact has recently been brought to our attention by Bier, Schede, and others: that is, the fallacy of the old idea that by the use of cups, heat, iodine, blisters, etc., superficial congestion produces a deep anemia. This is often spoken of as "depletion of the part affected," and while this may occur to some degree in very mild forms of counter-irritation, in most cases hyperemia is probably produced.

METHODS OF APPLICATION. *Active Hyperemia.* Hot air has been used to produce hyperemia as long as the healing art has existed, and every one is familiar with the use of hot baths, hot fomentations, sun baths, steam baths, and the like. This method is particularly applicable to those chronic conditions in which thickenings, infiltrations, exudates, or adhesions exist, the result of a previous acute inflammation, as their absorption is much aided by flushing the parts with healthy blood. In certain neuralgias and other pains it is often of remarkable, although of uncertain benefit. Most of us are familiar with the well-known baking apparatus, and have used it with more or less success, depending upon the nature of the condition subjected to the heat. Bier has only simplified the method and narrowed its field of usefulness, thereby increasing the probability of successful treatment by its means. He recommends simple, inexpensive boxes made of wood free from resin, covered with cloth, and having the inner surface soaked in silicate to prevent burning. Openings are provided for the limbs, for a thermometer, and for the pipe from the apparatus generating the heat, which is simply a long sheet-iron funnel, under which an alcohol, gas, or electric lamp is placed. If gas is used, the lamp should always be lighted before placing it under the funnel. The lid should contain several holes to permit the escape of air, thus insuring dryness. Different-sized boxes, with differently placed openings are used for the various joints, although some degree of combination is possible.

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[4] Münch. med. Woch., 1905, No. 16.

The limb is placed in the box, the lamp lighted and placed under the funnel, and the temperature gradually raised to a point which is comfortable to the patient. This may be 150° F., or it may be even as high as 250° F. It should be borne in mind, however, that with increased heat the part becomes less and less sensitive, and at 250° to 300° F., sensation is almost nil, so that burns may occur. After one-half to one hour of treatment the lamp is turned off, and fifteen minutes later the limb may be removed from the box. The length of treatment and whether it be given daily or not depends upon the reaction.

Passive Hyperemia. No adequate English word has yet been devised as the equivalent of *Stauungshyperämie,* the usual designations used being passive, congestive, induced, or obstructive hyperemia. Allen and Meyer believe that the German word should be taken over bodily into our language, but as most of the articles upon the subject are classified in the indexes as passive hyperemia, I have preferred in this article to use that term. When the condition to be treated involves the head, extremities, scrotum, or testicles, the hyperemia is produced by means of an elastic bandage. When this is not feasible, as upon the back, chest, pelvis, and surface of the body generally, various forms of suction apparatus are used.

The elastic bandage used by Bier is made of soft rubber, 2½ inches wide and sufficiently long to be wrapped six or eight times around the limb, and then fastened by a safety pin, tapes, etc. The method he adopts is about as follows: If the condition to be treated is, for example, an infection of the foot, the bandage would be wound about the thigh, each time overlapping slightly. The bandage is put on sufficiently tight to hinder definitely the venous return, but not sufficiently so as to diminish the arterial flow, the latter point being determined by feeling the pulse below the obstruction. In a few minutes the limb begins to swell and becomes of a deep red color up to the bandage, the skin feeling warm to the touch. When the swelling is well established serum begins to escape freely from any wound which may be present. A little later the limb appears bluish or bluish red, but it should never be white or blotchy.

The swelling or œdema is always present if the bandage is continued for several hours, and need occasion no alarm if the pulse is felt below, the limb is warm, and pain is absent. This œdema, however, should not be allowed to persist, but between applications absorption should be promoted by elevating the limb and by massage. The bandage remains in situ for from one to twenty-two hours, depending upon the condition for which treatment is instituted, but its position should be changed after about ten hours in one place. When long applications are used the skin may be protected by a soft flannel bandage beneath the rubber. The bandage must always be placed upon a healthy portion of the limb. When the patient's tissues are very sensitive, an inflatable tube may be used, similar to the arm band of the Stanton sphygmomanometer. Such a bandage has been described by Henle[5] and more recently by Wilson[6] and Grace.[7] The use of webbing instead of rubber has also been suggested.

Bier insists upon the utmost care and watchfulness, especially in the first day or two. The physician himself should attend to the treatment, as the method is capable in acute cases of doing almost as much harm if improperly applied, as it does good if correctly done. The progress of the case is gauged by the local appearances and symptoms—disappearance of pain, improvement in pulse, lowering of temperature, and finally the less and less response of œdema to the bandage. In the interval there may be a rise in temperature due to the setting free of toxins, and in septicemia the action upon the temperature may for some time be inappreciable.

The following must be rigidly avoided to insure success: Pain, paresthesia, white œdema, coldness of the skin, and obstruction of the arterial blood supply. All dressings and bandages must be removed the wound being protected by a loosely applied sterile towel; severe cases should be treated in bed; all pus should be evacuated by as many incisions as may be necessary, but these need not be as long as when passive hyperemia is not used, nor should the wound be packed or curetted; free incisions are only required when the circulation of the part is seriously impaired.[8]

Suction Apparatus. Although cupping has been practised since time immemorial to "relieve inflammation" and has been used in a more or less crude manner for years in the treatment of ulcers and infections, yet the method was not upon a scientific footing until Klapp, with the aid of an instrument maker, perfected the various shaped cups now on the market, and showed how they could be used with astounding success. These cups are devised to fit any part of the body, a furuncle on the neck, an abscess on the buttock, or a fistula at the knee-joint, for instance. The cup simply consists of a glass bell, with a heavy and usually curved rim to fit on a curved surface and a bulb attachment to exhaust the air. There are two essentials to be grasped before applying this method of treatment: (1) The diameter of the cup must exceed the area of infiltration; and (2) the amount of pressure must be regulated, because if the vacuum is too little, nothing is attained, and if too great, pain and white œdema are produced.

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[5] Zentralb. f. Chir., 1904, No. 13.

[6] Jour. Amer. Med. Assoc., 1908, i, 1122.

[7] New York Med. Jour., July 4, 1908.

[8] See remarks under Excessive Reaction.

The rim of the cup selected is greased with vaseline, and the bulb compressed in the right hand; the cup is then applied over the furuncle or sinus, and the pressure slowly released. The skin and underlying tissues are sucked into the cup; the hyperemia appears as a red or bluish coloration; pus, serum, and blood ooze from the wound. At the end of five minutes the cup is gently removed, the exudate wiped off, and the part allowed to rest for three minutes, whereupon the cup is again applied. This intermittent treatment is continued for forty or forty-five minutes, and then a simple dressing applied. After the united suction a limpid serum is constantly exuded, sometimes containing blood corpuscles and bacteria, in amounts reaching from 5 to 8 c.c. Treatment is continued every day, gradually decreasing the time of application as the discharge becomes thinner and the granulations become red and firm. Sometimes a scab or crust forms over the sinus which requires removal before beginning treatment. I find the use of Wright's sodium citrate chloride solution very advantageous in preventing clogging of the sinus with thick exudate. Squeezing, probing, curetting, or the use of drains is absolutely contra-indicated. Unless seen in the early stage, furuncles, carbuncles, suppurating lymph nodes, or abscesses should be opened by a small incision, and the cup applied immediately. Cold abscesses may safely be opened if due care is exercised in their protection, but should not be curetted, probed, or injected with iodoform emulsion; nor is immobilization necessary. Very large suction glasses are made for the treatment of puerperal mastitis, and are provided with a suction pump and stopcock arrangement. Finally, large and rather expensive glass vessels are made, into which a whole limb may be placed and suction applied. With the exception of a small one to fit the finger in the treatment of felons, they can be superseded by the elastic bandage. They can easily be made for the hand and wrist, however, by fitting a rubber sleeve to the opening of a large glass irrigator and a tube and stopcock to the outlet pipe. A Martin rubber bandage wound around the cuff makes it fit air-tight around the arm. A bicycle pump is used to produce the vacuum. Their best use is seen in orthopedic practice, as stiff joints may be gradually mobilized in a nearly painless manner.

Mode of Action. Bier does not ascribe the beneficial action of passive hyperemia to any one factor, and, owing to the complexity of theories regarding the protective process of the body against infection or toxemia, it is difficult to explain clearly, by scientific reasoning, how this method exactly acts. Bier, in his early publications, offered no explanation, except the flushing effect of the saturation of the tissues with serum, and compared the process to an irrigation system, in which the outflow is interferred with and the soil inundated to an overflow. In later communications he states his belief that the bacteria and their toxins are rendered harmless and further necrosis of tissues prevented by the superabundant nourishment. Much experimentation has led to some elucidation of the problem. Bier groups the beneficial effects under the following headings:

1. *Relief of Pain.* This is particularly emphasized by Bier, and serves as the main criterion by which the progress of the case is recorded. The pressure of exudate is not now considered as the cause of continued pain, but this is thought to be due also to the irritation of the sensory nerve endings by toxins. Ritter[9] believes that hyperemia reduces the sensibility of tissues by diluting the toxins, and also by correcting the isotonic difference between the products of inflammation and the tissues in which they lie. The pain usually recurs in the intervals of treatment, at any rate, for the first few days, and in spite of the most careful application of the method I have several times in bone lesions produced an increase of pain by the constricting bandage.

2. *Bactericidal Action of the Serum.* The experimental proof which Bier offers in support of the action of the œdema upon the bacteria in the affected tissues is mostly based upon the findings of Nötzel,[10] in 1899. This experimenter injected fatal doses of anthrax and virulent streptococci into the tissues of 67 rabbits in which passive hyperemia had been produced. Fifty-one lived and 16 died, the latter, however, all had the "white œdema," which is to be strictly guarded against in producing the congestion. The control rabbits all died. Joseph,[11] Colley,[12] Hamburger,[13] and Lacquer[14] believe that the œdematous lymph, produced during periods of congestion, is markedly bactericidal. Baumgarten[15] agrees with Nötzel's findings if the dose of anthrax bacilli is not large, but he obtained negative results after injecting tubercle bacilli. While believing that there is a certain bactericidal action on the part of the accumulated blood serum, he suggests that this is not vigorous and that the death of bacteria may be due to the lack of nourishment in the media. This seems to me to be based on false premises, in view of the well-known predisposition of chronic œdema to bacterial invasion.

On the other hand, many experimenters have failed to obtain this bactericidal action, among the more recent being Wrede,[16] Frangenheim,[17] Graff,[18] and Walther.[19] Wrede, in particular, believes that the bactericidal power is uncertain and can be used only in a limited way, and in 50 cases he repeatedly examined the incised focus and was unable to demonstrate by enumeration a marked decrease in the organisms. He also examined unopened foci, joints, for instance, which had been treated for some time by passive hyperemia, and found many actively growing bacteria.

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[9] Arch. f. klin. Chir., Band lxviii, S. 429.

[10] Arch. f. klin. Chir., Band lx, Heft 1

[11] Münch. med. Woch., 1906, No. 48, S. 2370.

[12] Ibid., 1906, No. 6.

[13] Virchow's Arch., 1899, Band clvi, S. 329.

[14] Zeit. f. Exper. Path. and Therap., 1905, Band x.

[15] Münch. med. Woch., 1906, Band iii, No. 48.

[16] Surg., Gynec., and Obstet., 1908, vii, 288.

[17] Arch. f. klin. Chir., 1908, Band lxxxvii, Heft 2.

[18] Beit. z. klin. Chir., 1908, Band lix, Heft 3.

[19] Virchow's Archiv, 1908, Band cxciv, Heft 1.

Without going into the controversy in detail, it may suffice to point out that in all probability the success of this method of treatment depends upon the coincident working of increased serum, bacteriolysis, and phagocytosis. By increasing the pressure in the capilaries the focus of infection is flooded by a lymph having antitryptic and opsonic powers, arresting the further destructive action of ferments and inhibiting bacterial growth. When the bandage is removed the dammed circulation reëstablishes itself; the lymph moves out of the affected part, liberating more or less endotoxin, which exerts an influence upon the antibactericidal power of the blood generally by the stimulation of antitoxins, alexins, opsonins, etc. If any of the factors of this relation are altered the results of the method must vary. Thus, the period of the so-called "positive phase" is the most favorable for the success of Bier's method, as the blood serum comes to the focus of infection charged with bactericidal and bacteriolytic properties, and the leukocytes and opsonins are powerfully phagocytic. If the organism, on the other hand, is depressed and in the so-called "negative phase," passive hyperemia may fail in its purpose, or, what is more important, the liberation of the endotoxins in excessive amount, during the pause, may seriously affect the condition of the patient. For these reasons I believe that we will shortly have to modify the extravagant and universal claims of success for this treatment, and so balance the surgical incision, the artificial use of opsonins, and the increased lymph flow by passive hyperemia that they will each have their applications singly or together. At any rate, it seems as though, just as asepsis has succeeded antisepsis in operative technique, so will a more rational treatment of acute and chronic suppuration based on modern scientific principles succeed the douching of wounds with chemicals and their irritation by the continuous presence of foreign substances. It is well known that a film of necrosis results from the use of strong chemicals injuring the histological elements, and it should be equally well understood, as stated by Wright, "that the antiseptic will directly antagonize the protective forces which the living organism has at command, will paralyze the phagocytes, and will abolish the antibacterial power of the body fluids."

The papers published by Lexer[20] and by Wolff-Eisner,[21] in 1906, are very suggestive and emphasize the importance of recognizing the danger of the toxins produced by the bacteriolysis in severe cases. During the interval or pause in the treatment the œdema disappears and "the body is flooded by the œdema fluid which carries with it the soluble substance of the inflammatory process" (Wrede). This is often evident clinically by the rise in temperature and sometimes by chills, etc. Lexer, therefore, points out that this injurious action may be avoided in severe acute cases, by large and early incisions in place of the small ones recommended by Bier. Such treatment also prevents the spreading of the endotoxins into hitherto intact areas. Wolff-Eisner states that the indications for Bier's hyperemia are the same as for the bactericidal serums, the hyperemia being most favorable when complete bacteriolysis is present, and the number of bacteria small. This is seen in mild cases and in severe cases treated early. He also observed that sometimes in streptococcic infection, either pure or mixed with staphycococci, the Bier treatment failed or actually caused a general exacerbation.

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[20] Münch. med. Woch., Band liii, No. 14.

[21] Ibid., Band liii, No. 23.

3. *The Resorption of Toxic Products.* Bier advances many ideas from physiological experiments to support this effect of hyperemia, of course basing his contention upon the well-known increase of lymph flow as the result of venous obstruction. Thus, Joseph measured the amount of œdema by the displacement seen when the limb is placed in a cylinder of water before and after the constriction. In one experiment he found that 450 c.c. of fluid passed out of the arm. If we are able to eliminate the effect of the liberated toxins upon the organism, these results would be ideal for all cases, but, as remarked before, the endotoxins must, if excessive, be reckoned with.

4. *The Softening and Solution of Blood Coagula and Exudate.* Bier states that adhesions, cicatrices, and contractions about joints become soluble under the influence of enzymes in the lymph with which they are flooded, and then absorbed. The flooding of unhealthy tissue during the intermittent œdema is followed by its absorption in the intervals and its replacement by a large amount of new healthy tissue. It is probable, also, that the increased number of phagocytes is a very important factor in favoring absorption.

5. *Increased Nutrition.* But little need be said on this point, as it has been believed since Virchow that hyperemia increases nutrition. The zone of reaction and cell growth usually seen about a focus of necrosis is evidence that the cells are actively assimilating. Care must be exercised not to prolong the hyperemia unduly nor to allow a condition of chronic œdema to occur, in which events the vitality of the tissues will be lessened, and the process become generalized.

CLINICAL APPLICATION. To attempt even a brief description of the various diseases for which hyperemia, active and passive, has been recommended would far transgress the limits of this paper. It suffices to state that from meningitis to gout and back again the list includes nearly every infection or nutritional disorder to which the body is heir.[22] The following are selected as types of the more common conditions to which the method is applicable. In general, it may be stated, "that for conditions due to bacterial invasion the passive form of hyperemia is to be used, while for the non-bacterial conditions the active variety is applicable."

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[22] For a full description of these the reader is referred to Bier's Hyperämie als Heilmittel, where over 200 pages are devoted to a discussion of the clinical uses of hyperemia.

The beginner should always bear in mind the possible danger of manipulating the blood stream, and at first limit his endeavors to early acute and subacute inflammations, especially those that ordinarily give a good prognosis. Furuncles, carbuncles, paronychias, felons, mastitis, lymphadenitis, etc., are all disorders in which suction can be employed with great benefit. Diffuse inflammatory infiltrations, unaccompanied by softening, and especially when the streptococcus is believed to be the causative organism, are not suitable for the treatment. If these are accompanied by fever and other evidence of constitutional disturbance, or if the process is rapidly spreading locally, passive hyperemia only does harm. In wide open accidental and operative wounds the method is of value. In general, it may be stated that disease of bone is very rebellious to the treatment, as it is, however, to any other method, because of the impossibility of producing any degree of œdema in the dense tissue.

Tuberculous Arthritis. In the treatment of this affection, as well as in all forms of surgical tuberculosis, passive hyperemia alone must be used and never hot air. The treatment aims slowly to produce a connective-tissue overgrowth, which replaces the tuberculous granulations; consequently the method requires much patience in its application, as frequently twelve or fourteen months are required to produce a cure. Some recent researches by Felegyhazi[23] show that in tuberculous sinuses examined microscopically the effect of passive hyperemia is to produce an increased formation of connective tissue. He believes that while phagocytosis is active in suppressing any mixed infection present, the result of the treatment depends upon the walling in of the tuberculous foci by the connective tissue. He also pertinently remarks that he is uncertain, until further experiments have been carried out, whether these submerged bacilli are eventually destroyed, or whether a trauma may set them free at a future date. The bandage is applied about the thigh or arm sufficiently tight to produce a bluish-red coloration, and, as a general rule, should remain in place for one hour twice daily. This may be decreased if found necessary or may be increased to two hours twice daily if better results are obtained by the longer application. Occasionally it may be found advisable to stop the hyperemia for a few days if the condition remains stationary. Great care should be taken of the part of the limb where the bandage is being applied, frequent changes of the point of application and gentle massage with oil being advisable. While complete immobilization is to be avoided, the patient should not subject the limb to any weight or strain, particularly in the early stages. Cold abscesses frequently occur and must be opened as soon as detected, treated by the suction glasses in the manner described previously, and protected from contamination. As contra-indications, may be mentioned commencing amyloid disease, advanced phthisis, large abscesses filling the whole joint, faulty position of the joint with bony ankylosis, and "arthritis tuberculosa exsudativa" (hydrops). Several years ago Bier claimed 88 per cent. of cures in the hand and wrist, 72.7 per cent. in the elbow, 61.5 per cent in the foot and ankle, and 23 per cent. in the knee condition. The cold abscesses arising from Pott's disease of the vertebræ should not be subjected to suction unless it is absolutely necessary to open them, when the cups may be used to prevent mixed infection.

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[23] Deut. Zeit. f. Chir., 1908, Band xciii, Heft. 5.

Gonorrhœal Arthritis. This disease is considered one of the most favorable for hyperemic treatment, not only because of the good result ultimately obtained, but also because of the early relief of the excruciating pain with which it is accompanied. It requires considerable judgment in interpreting whether good or harm is resulting and the method must be used with caution. The bandage should be applied twice in the twenty-four hours for ten or eleven hours each time, and during the pauses the œdema must be made to disappear by elevation and gentle massage, at which time the effect of treatment must be carefully scrutinized. Distention of the joint with pus or seropurulent fluid must be prevented by aspiration followed by irrigation with saline solution. Baetzner[24] reports 40 cases so treated in Bier's clinic, in which the duration of the condition was shortened, pain promptly relieved, early immobilization obtained, and ankylosis prevented in all the cases. Local treatment of the posterior urethra, prostate, etc., should, of course, be carried out at the same time.

Sufficient information is given in the preceding paragraphs to enable the practitioner to understand the principles and mode of application of this method of treatment. Especial emphasis must again be laid upon the dangers which may occur by its indiscriminate and unskilful use in acute infections, and, on the other hand, praise must be given in no stinted manner to the efforts of Bier to bring the method to the attention of the medical world. For sixteen years he has persistently advocated the use of hyperemia, both active and passive, and now, as the successor to von Bergmann at Berlin, he is in a position to command attention. In any inflammatory lesion where exudate, necrotic or plastic, is present, or whenever bacterial invasion of the tissues requires to be checked, the method is of more or less distinct value if it can be applied, but it must simply be regarded as an adjuvant to other older and well-known methods, and not as a panacea for all ills.

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[24] Deut. Zeit. f. Chir., 1908, xciii, Heft. 1.